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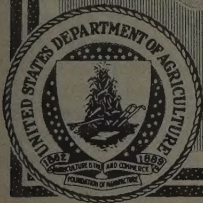
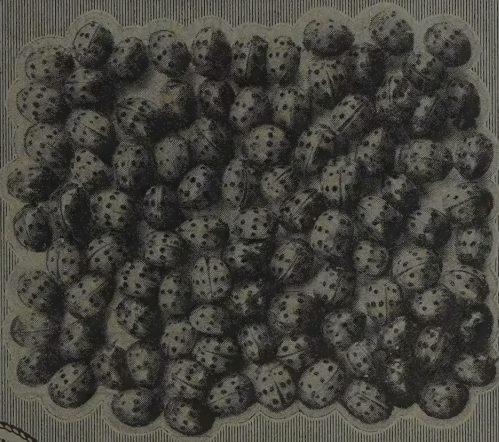
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U. S. DEPARTMENT OF AGRICULTURE

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The MEXICAN BEAN BEETLE IN THE EAST



U. S. DEPARTMENT OF AGRICULTURE

THE Mexican bean beetle in its range of distribution is the most serious insect enemy of beans in the United States. In the Southeast it was first found in Alabama in 1920, and now infests large areas in Alabama, Georgia, Tennessee, and Kentucky, and smaller areas in the Carolinas, Virginia, Mississippi, and Ohio. It is spreading northward rapidly and may soon extend its range over most of the Eastern States.

The adult is a copper-colored beetle, bearing eight black spots on each wing cover, and is about one-fourth of an inch long. The larva is orange colored and is frequently described as "fuzzy."

This insect feeds on the plants of all kinds of table beans, cowpeas, soy beans, beggarweed, and others of lesser importance. The principal injury is done to the foliage, but in cases of heavy infestation green pods also are destroyed.

Magnesium arsenate, used as a spray or as a dust, is the most promising insecticide. Calcium arsenate combined with hydrated lime is also useful.

Heavily infested fields should be plowed under as soon as the crop is off, and the grower should not plant more beans than can be properly treated.

THE MEXICAN BEAN BEETLE¹ IN THE EAST.

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CONTENTS.

	Page.		Page.
The most destructive insect to growing beans-----	1	Natural agencies of control-----	7
Appearance of insect and nature of damage-----	1	Control measures-----	8
The insect in its different stages-----	3	Sprays-----	8
Regions in which this beetle is found-----	4	Directions for applying the spray-----	8
Life history and habits-----	5	Dusts-----	9
Hibernation-----	6	Applying the dusts-----	9
Food plants-----	6	Cultural practices favorable for control-----	11
		Summary of control measures-----	13

THE MOST DESTRUCTIVE INSECT TO GROWING BEANS.

THE MEXICAN BEAN BEETLE is the most serious insect enemy of beans in those parts of the United States which it inhabits. It has been long present in the Southwestern States, where it is as injurious to beans as the Colorado potato beetle has been to potatoes. In 1920, it was discovered at Birmingham and Blocton, Ala.

After becoming established over an area of about 4,500 square miles in northern Alabama, this pest destroyed practically all the beans in that section in 1921. It was injurious also to cowpeas, a hitherto unknown food plant, in some cases where this crop was growing in the vicinity of bean fields.

APPEARANCE OF INSECT AND NATURE OF DAMAGE.

The Mexican bean beetle is nearly hemispherical, one-fourth of an inch long and about one-fifth of an inch wide. Each of the brown wing covers bears eight black spots (fig. 4). The beetle closely resembles some of the native beneficial ladybirds, to which family of insects it belongs.

The larva is orange colored, varies in length from about one-twentieth of an inch when young to about one-third of an inch when full grown, and is covered with long, branched spines.

Injury by the larva and adult of the Mexican bean beetle to the bean plant is characteristic. The adult, feeding from below, eats ragged areas in the lower surface of the leaf, but often cuts through

¹ *Epilachna corrupta* Muls.; order Coleoptera, family Coccinellidae.

the upper surface, giving the foliage a lacelike appearance (fig. 2). The larvæ usually feed on the under surface of the leaf, leaving the

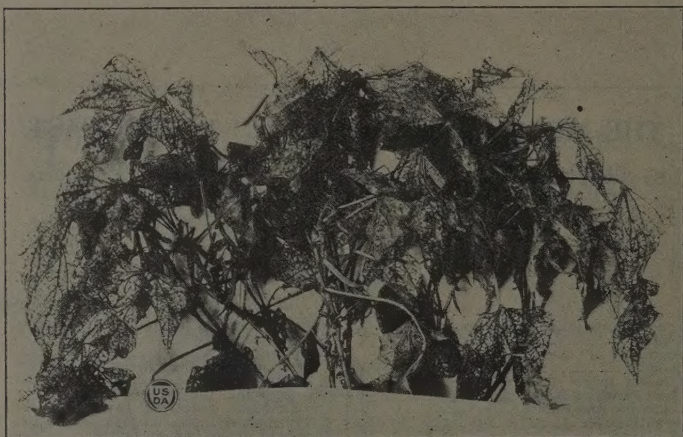


FIG. 1.—Bean plants in field, destroyed by Mexican bean beetle.

upper surface intact. The lower tissue is cut away in narrow parallel sections about the length of the insect's body. Between these



FIG. 2.—Adults and larvæ of Mexican bean beetle on under side of bean leaf, showing areas eaten by adults. Slightly enlarged.

sections are narrow strips which are left untouched by the larva, resulting in a peculiar network not likely to be mistaken for the work of any other insect (fig. 3).

All parts of the plant above the ground are fed upon by both beetle and larva. When the insects are numerous, the plant is destroyed and presents the appearance of having been completely dried out (fig. 1). After destroying the foliage, the insect may attack the pods, and even the stems. Injury to cowpeas and soy beans is similar, but attack on the stems and pods of these plants is very rare.

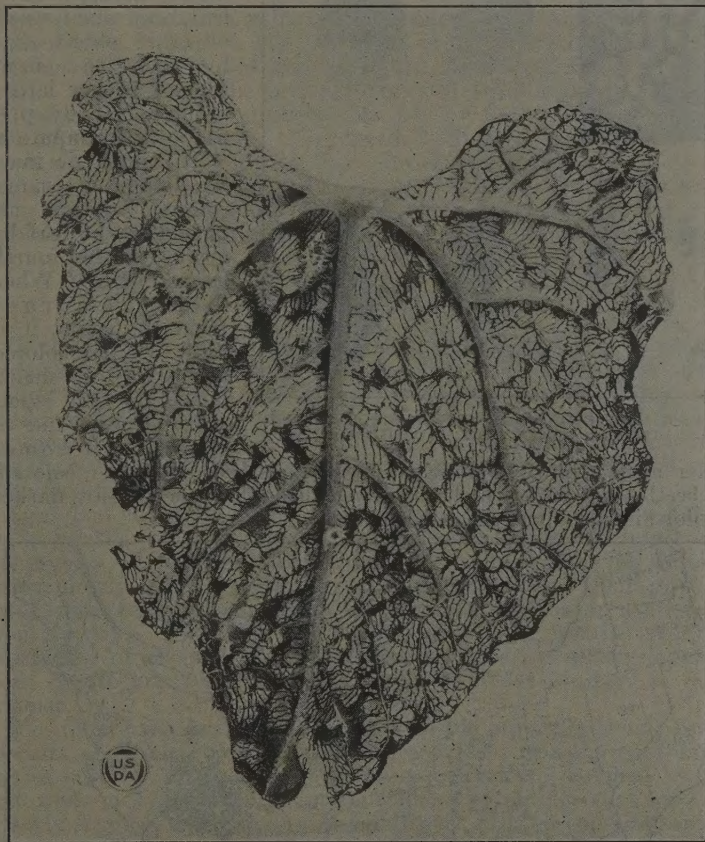


FIG. 3.—Feeding of larvae of Mexican bean beetle on bean leaf. Slightly enlarged.

When the beetles are abundant, a bean crop may be completely destroyed in about four weeks, or before the pods are grown.

THE INSECT IN ITS DIFFERENT STAGES.

The eggs of the Mexican bean beetle are deposited in clusters of from 40 to 60 on the lower surface of a leaf. (Figure 4 illustrates the different stages of the insect.) The eggs are orange-yellow and when examined under a microscope are seen to be sculptured. The larva when first hatched is about one-twentieth of an inch long and

after a few hours begins feeding on the under surface of the leaf close to the egg group. Each larva molts three times, becoming larger until it is full grown, when it is about one-third of an inch

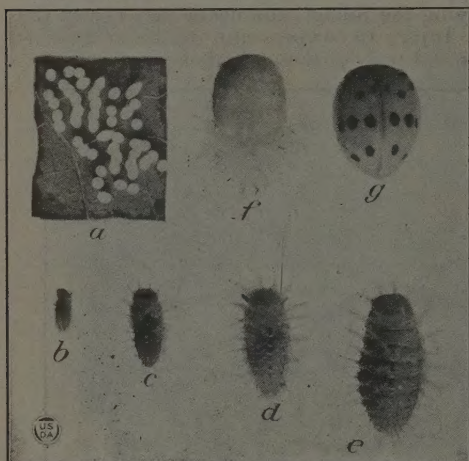


FIG. 4.—a, Eggs of Mexican bean beetle; b, c, d, e, first to fourth stages of larva; f, pupa; g, adult. Enlarged.

long and one-sixth wide. It then attaches itself to the under surface of a leaf, bean plant, weed, or other object near by, and becomes shorter but larger around the body, preparatory to pupation. The pupa or inactive stage is orange colored, and is attached to the leaf by means of the fourth larval skin. When the adult emerges from the pupa, it is light-lemon colored and shows no markings, but the spots soon appear and it gradually becomes

darker until after a week or 10 days it has become copper colored. Old beetles and those which have lived through the winter are darker in color and the spots are less distinct.

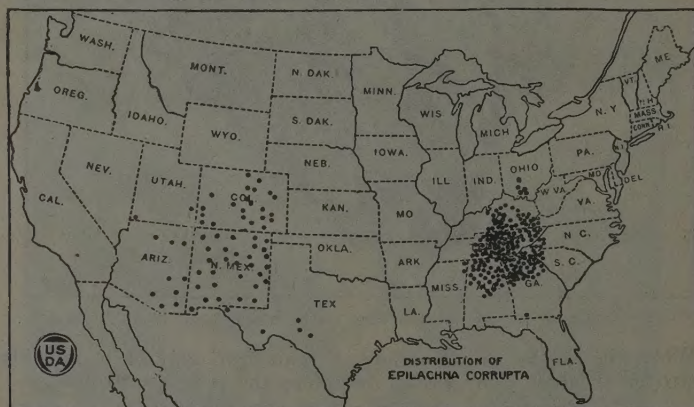


FIG. 5.—Map showing the known distribution of the Mexican bean beetle in the United States.

REGIONS IN WHICH THIS BEETLE IS FOUND.

The Mexican bean beetle originally came from Mexico. It has been known in the western part of the United States since about 1850.

In this region it is now known to exist in Arizona, New Mexico, western Texas, Colorado, and Utah.

In 1920 this pest was discovered in northern Alabama and by the fall of that year it had been found in portions of 13 counties. The next year it spread over an area about 10 times as large and was present in parts of 6 States. In 1922 it spread almost to the Ohio River in Kentucky, and into Virginia. It is now known to be present in all of these States, as well as in Mississippi and Ohio. (See fig. 5.) Undoubtedly in time it will extend its range over most of the hilly portions of the United States east of the Mississippi River.

This spread from the original point of infestation in northern Alabama has been accomplished mainly by flight, with the assistance of prevailing winds. The beetle is sluggish in its movements but is a comparatively strong flier, and during spring and late summer may fly many miles. Marked beetles have, within two days, been captured 5 miles from the point where liberated. During 1921 a spread of over 200 miles northward occurred, and in 1922 a spread of over 100 miles.

LIFE HISTORY AND HABITS.

In the latitude of Birmingham, Ala., the beetles begin to emerge from their winter quarters in late March or early April, just as the earliest garden beans are coming up; and by the middle of May most beetles have left their winter quarters, a very few, however, remaining there until about the first of June. On emerging from hibernation the beetles fly to near-by bean fields and the females deposit eggs after feeding for a few days.

Eggs laid in early spring require from 10 to 14 days to hatch. As the weather becomes warmer the eggs hatch in less time, until only 5 or 6 days are required. Larvæ that hatch in early spring develop rather slowly, and may require 5 weeks to complete their growth. Later in the season development of the larvæ requires an average of about 20 days. The pupal period during summer weather requires an average of about 7 days. Thus the total period of development from egg to adult requires an average of about 33 days in mid-summer.

Within two weeks after emerging from the pupa the female beetle deposits eggs, and the life cycle is repeated. Some overwintered beetles may live until July, but the majority have perished by the first week in June. The insect reproduces so rapidly that by July or early August, under favorable conditions, it has become extremely abundant. Two generations are necessary for the maintenance of the insect in the Southeastern States, but a maximum of three or even four may occur. In the West and Southwest one generation is the rule, but in some sections a second generation occurs.

In August the beetles become restless and fly from field to field. At this time undoubtedly much of the spread into new territory takes place. Late in September and early in October the first beetles seek winter quarters, and others follow until about the first frost, in late October or early November, at which time practically all beetles have left the fields. All stages are present in the field from April until November, but eggs and larvæ usually become scarce during September and October.

HIBERNATION.

Only the adult lives through the winter. It hibernates preferably in woodlands near bean fields. It is semigregarious in habit. As many as 329 beetles have been found in one group covering less than 3 square feet, under pine needles and oak leaves on a well-drained,



FIG. 6.—Mexican bean beetle hibernating under pine needles and leaves in woods.

woodland hillside near cultivated bean fields (fig. 6). About 50 per cent hibernate singly, a few in and about the field or garden under rubbish and plant remains. The insects have been found hibernating three-fourths of a mile from the nearest field, but the majority occur within a quarter of a mile. In the West the beetle may fly many miles to hibernate. In the Southeastern States complete dormancy does not occur throughout the entire winter, since the beetles crawl about on warm days.

FOOD PLANTS.

The Mexican bean beetle is primarily a bean pest, preferring the common bean and the lima bean to other plants. Its second choice is beggarweed,² or beggartick, which grows wild generally throughout the Southeastern States, and is cultivated for hay in some

² *Meibomia tortuosa* and *M. canescens*.

sections. The insect can reproduce successfully on cowpea and soy bean, and in some cases does injury to these crops. It also eats the hyacinth bean, adzuki bean, alfalfa, and sweet clover, but the last three are not desirable food plants and in many instances the insect dies when confined to them. When the insect is extremely abundant and when bean foliage has been destroyed, the beetle, and in some cases the larva, feeds on velvet bean, kudzu, crimson clover, white clover, corn, grasses, okra, eggplant, potato, squash, mung bean, and some weeds. Adults have also been observed feeding on Japan clover and downy milk pea.³

NATURAL AGENCIES OF CONTROL.

No internal parasite of the Mexican bean beetle had been recorded until 1922 when two native species of flies⁴ were found to parasitize the insect in rare instances in northern Alabama.

A number of predacious insects feed on the eggs and young larvæ, and in some cases on the older larvæ, pupæ, and adults of the Mexican bean beetle. The most common of these in the Southeastern States is the spotted ladybird,⁵ which feeds sparingly on the eggs and young larvæ. The "anchor bug"⁶ in both immature and adult stages preys on larvæ, pupæ, and adults of this bean beetle. The spined soldier bug⁷ attacks all stages. A few other bugs and a few beneficial ladybird beetles feed on different stages of the bean beetle, but are of little importance.

A tachina fly parasite⁸ of this bean beetle is prevalent in some sections of Mexico, and efforts are being made to introduce the species into the United States.

Since the appearance of the Mexican bean beetle in the Southeast, this pest has varied as regards abundance. In general, the numbers of this insect decreased during 1922 and 1923. Soon after the insect reaches a new section, injury is usually extremely severe, and the second season after its arrival the bean crop is very likely to be destroyed.

In the West this pest varied from year to year in its injury to the bean crop, and it is probable that this will be true of the infestation in the East. No explanation for this can be made other than that weather conditions are probably the most important factors. Heavy rains during spring and summer seem to be detrimental to the insect, but extreme drought has not been observed to act as a material check so long as the insect's food plants do not become too dry.

The intense heat in the bright sunlight during heated periods in summer kills many larvæ and pupæ. When dry weather causes the bean leaves to curl, or when varieties of beans which have this habit are grown, many egg masses, larvæ, and pupæ are exposed to the sun and die. This has been observed only under conditions of extreme infestation, where insects were so abundant that they covered both the exposed and unexposed sides of bean plants and surrounding vegetation.

³ *Galactia volubilis*.

⁴ *Phorocera claripennis* Macq. and *Helicobia helici* Towns.

⁵ *Megilla maculata* DeG.

⁶ *Stiretrus anchorago* Fab.

⁷ *Podisus maculiventris* Say.

⁸ *Paraderodes epilachnæ* Ald.

CONTROL MEASURES.

SPRAYS.

The Mexican bean beetle can be successfully controlled by the use of certain arsenical poisons. Spraying has given best results for

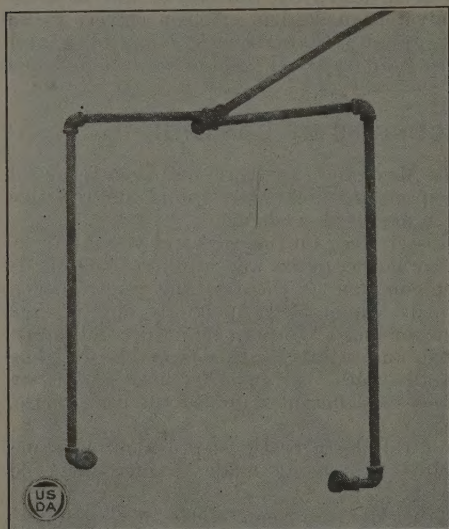


FIG. 7.—Proper arrangement of boom and nozzles for use with wheelbarrow or barrel sprayer.

the past three seasons, 1921 to 1923. On account of the susceptibility of the bean plant to arsenical injury, arsenicals must be applied carefully. In the South-eastern States lead arsenate and zinc arsenite, which are reported to be useful in the West, have been found too injurious when tried on bean foliage to warrant their use under any conditions. Calcium arsenate, undiluted, is very injurious to bean foliage, but a high grade may be successfully used by adding lime as shown in the formula below. For the last three seasons magnesium arsenate has given best results because it does not

“burn” foliage. One of the following sprays may be used effectively, at the rate of 90 to 100 gallons to an acre.

MAGNESIUM ARSENATE SPRAY.

	For large areas.	For small areas.
Magnesium arsenate ⁹	2 pounds.	1 ounce.
Water	100 gallons.	3 gallons.

CALCIUM ARSENATE SPRAY.

	For large areas.	For small areas.
Calcium arsenate ¹⁰	1½ pounds.	¾ ounce.
Lime	3 pounds.	1½ ounces.
Water	100 gallons.	3 gallons.

DIRECTIONS FOR APPLYING THE SPRAY.

Since the Mexican bean beetle feeds on the under surfaces of the leaves, it is necessary to direct the spray to these parts. This can best be done by placing the nozzle, preferably a 45° angle nozzle, on a 90° elbow, at the end of the spray rod (fig. 7). Where two nozzles are used to the row, one nozzle should be turned slightly forward, so that the sprays will not meet too closely.

⁹ Less than 0.5 per cent water-soluble arsenic pentoxide.

¹⁰ Less than 0.2 per cent water-soluble arsenic pentoxide.

For gardens and very small patches a small compressed-air hand sprayer may be successfully used. (See fig. 8 for illustrations of sprayers.) For fields from half an acre to 2 acres in size, a barrel sprayer may be mounted on a wagon and a row sprayed from both sides by the arrangement of the nozzles on a boom, or a wheelbarrow sprayer may be mounted on a slide and one row at a time treated in a similar manner at walking speed. While neither of these types of machines is all that could be desired, a grower with less than 4 or 5 acres of beans can hardly afford to invest in a high-priced traction sprayer for this use alone. Growers who have 5 or more acres of beans should use a traction type of horse-drawn sprayer or a power sprayer which will spray at least two rows at once. On larger acreages a 4-row sprayer should be used.

The larger sprayers should be fitted with a boom so that three nozzles may be directed to each row. Excellent results can be obtained if the rows are straight and are planted at regular distances. At least 150 pounds pressure should be maintained.

DUSTS.

Although spraying with liquid poisons has given consistently better results against this bean beetle than dusting, the latter form of poison is becoming more popular year by year, and in the infested territory most growers prefer to apply insecticides to their beans in dust form. Also, where medium infestation exists, dusting gives good results. The following mixtures have been successfully applied, and the grower should choose the one best suited to his use:

MAGNESIUM ARSENATE DUST.

For very heavy infestation:

Magnesium arsenate ⁹	1 part.
Hydrated lime	3 parts.

The rate of application is 10 to 12 pounds per acre.

For lighter infestation:

Magnesium arsenate ⁹	1 part.
Hydrated lime	5 parts.

Rate of application, 12 to 15 pounds to the acre.

CALCIUM ARSENATE AND LIME DUST.

Calcium arsenate ¹⁰	1 part.
Hydrated lime	9 parts.

Rate of application, 15 to 20 pounds per acre.

CALCIUM ARSENATE, SULPHUR, AND LIME DUST.

(Alabama Experiment Station Formula.)

Calcium arsenate ¹⁰	1 part.
Fine dusting sulphur	1 part.
Hydrated lime	4 parts.

Rate of application, 12 to 15 pounds per acre.

APPLYING THE DUSTS.

The dust should be directed to the under surfaces of the leaves, covering as much foliage as possible. Enough of the mixture should

⁹ Less than 0.5 per cent water-soluble arsenic pentoxide.

¹⁰ Less than 0.2 per cent water-soluble arsenic pentoxide.



FIG. 8.—*a*, Spraying beans in small garden with compressed-air sprayer; *b*, spraying beans in small field with wheelbarrow sprayer mounted on slide and drawn by horse; *c*, spraying large field of beans with horse-drawn power sprayer.

be applied so that between 2 and 3 pounds of the arsenical in the dust is distributed on an acre of beans. Where a 1-9 calcium arsenate mixture is used, the grower may apply 15 to 20 pounds of the mixture to the acre of bush beans, and good results may be obtained under favorable conditions with only 15 pounds. Where the calcium arsenate, sulphur, and lime mixture is used, 12 to 15 pounds is sufficient for an acre. Where magnesium arsenate is employed, 10 to 12 pounds of the 1-3 mixture or 12 to 15 pounds of the 1-5 mixture to the acre is sufficient.

Dust mixtures may be prepared on the farm by placing the ingredients in a steel drum or barrel, which is then tightly closed and rolled about for a distance of 400 or 500 feet. At the same time it should be tipped on end at intervals of about 50 feet.

Dust should be applied with a good duster; never with a sack. For gardens and small patches of less than a fourth of an acre, hand dusters of the bellows or air-pump type are satisfactory. (See fig. 9 for illustrations of dusters.) On fields over a fourth of an acre in size and up to 5 acres, a larger machine should be used. A knapsack type of bellows duster with a spout attached to a flexible hose is effective. The dust can be directed to the under surfaces of the leaves with this machine. A fan type of duster may be used if the nozzle is turned sidewise so that the dust is directed under the leaves.

Where 4 or 5 acres of beans must be treated at one time, a horse-drawn type of 2-row duster is preferable where rapid treatment is desired. The nozzles, as with hand dusters, should be directed to the under surfaces of the leaves.

In the treatment of more than 5 acres of beans, a 2-horse, 4-row duster is the most effective. Best results have been obtained with a traction type of machine. For all dusting and spraying operations, the rows should be planted equal distances apart and should be straight. On good soil the average distance between rows should be 3 feet.

There is practically no danger of arsenical poisoning from consumption of treated beans, but they should be rinsed twice in clear water before marketing to assure absolute safety.

CULTURAL PRACTICES FAVORABLE FOR CONTROL.

Under Mexican bean beetle conditions every effort should be made to grow a vigorous, quickly maturing crop. The land should be well tilled and well fertilized, and an early-maturing variety of beans, suitable to the locality, should be grown. In cases of severe infestation, the control of this pest on pole beans is expensive because of the slow maturity of the crop and the greater number of insecticide applications necessary. Pole beans can not be easily treated with horse-drawn machinery.

The spring crop should be planted as early as approved practice in the locality will permit. In 1922, in Alabama, the early spring crop was not severely injured before it was harvested, but plantings made a month later were in most cases either destroyed or severely injured.

The fall crop should be planted as late as possible. The beetle does not reproduce so rapidly in late August and September as in spring and early summer.



FIG. 9.—a, Small bellows duster suitable for home garden use; b, knapsack bellows type of duster for truck garden and small field use; c, 2-row horse-drawn duster in operation in 2-acre bean field; d, dusting beans for control of Mexican bean beetle with 4-row traction duster.

Where the bean beetle is extremely abundant, the plants should be plowed under as soon as the crop is picked. Thousands of eggs, larvæ, pupæ, and newly emerged adults may be destroyed in this manner. Covering the plant remains and insects with a few inches of soil with an ordinary plow is effective in destroying them.

SUMMARY OF CONTROL MEASURES.

Where the Mexican bean beetle thrives, growers must be prepared to practice remedial measures. Proper control measures may result in an excellent crop of beans alongside of untreated fields which are completely destroyed (fig. 10). Under bean beetle conditions, care-



FIG. 10.—Untreated beans destroyed by Mexican bean beetle beside beans sprayed with magnesium arsenate.

ful application of the following suggestions will largely protect the crop.

Apply magnesium arsenate as a spray at the rate of about 2 pounds to the acre, using 2 pounds in 100 gallons of water, and directing the spray to the under surfaces of the bean leaves.

Begin spraying when the eggs of the bean beetle become numerous. This is usually when the plants begin to send out their first true leaves. Apply the spray from one to four times to a crop of bush beans, depending on the abundance of insects, and at intervals of a week or ten days.

When spraying can not be conveniently practiced, apply one of the following dust mixtures:

Magnesium arsenate, diluted with from 3 to 5 parts of hydrated lime, using from 10 to 15 pounds of the mixture to the acre.

Calcium arsenate, diluted with 9 parts of hydrated lime, using from 15 to 20 pounds of the mixture to the acre.

Calcium arsenate, diluted with 1 part of fine dusting sulphur and 4 parts of hydrated lime, using from 12 to 15 pounds of the mixture to the acre.

- Apply the dust when little or no wind is blowing.
- Where the beetles are numerous, plant bush varieties of beans.
- Plant only as many beans as can be properly treated.
- In heavily infested areas, when a crop of green beans is removed, plow the plants under immediately.
- Remove accumulations of leaves and plant remnants from woodlands near bean fields.
- Do not burn over timberland. Burn over only waste places near bean fields.*

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